



## Standard Specification for Vermiculite Loose Fill Thermal Insulation<sup>1</sup>

This standard is issued under the fixed designation C 516; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

<sup>ε1</sup> NOTE—Keywords were added editorially in December 1996.

### 1. Scope

1.1 This specification covers the composition and physical properties of expanded or exfoliated vermiculite loose fill insulation. The specification also includes the testing procedures by which the acceptability of the material may be determined. These testing procedures deal primarily with material performance in the temperature range associated with the thermal envelope of buildings; however, the commercially usable temperature range for this insulation is from –459 to 1400°F (–272 to +760°C). For specialized applications, refer to manufacturer's instructions.

1.2 The specification also covers the composition and properties of vermiculite that has been surface-treated to produce water repellency for installations where liquid moisture may be a factor.

1.3 When the installation or use of thermal insulation materials, accessories, and systems may pose safety or health problems, the manufacturer shall provide the user with appropriate current information regarding any known problems associated with the recommended use of the company's products, and shall also recommend protective measures to be employed in their safe utilization.

1.4 The following safety hazards caveat pertains only to the test methods portion, Section 9, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Section 12.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates<sup>2</sup>

C 168 Terminology Relating to Thermal Insulating Materials<sup>3</sup>

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus<sup>3</sup>

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots<sup>3</sup>

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus<sup>3</sup>

C 520 Test Methods for Density of Granular Loose Fill Insulations<sup>3</sup>

E 84 Test Method for Surface Burning Characteristics of Building Materials<sup>4</sup>

E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C<sup>4</sup>

### 3. Terminology

3.1 The terms used in this specification are defined in Terminology C 168.

### 4. Classification

4.1 Vermiculite insulation shall be specified by two type designations and five classes, as follows:

4.1.1 *Vermiculite Loose Fill Insulation—Type I*—The product that results from the expanding or exfoliating of natural vermiculite ore by grading and heating to meet the requirements of this specification.

4.1.2 *Vermiculite Loose Fill Insulation—Type II*—Expanded vermiculite that has been surface-treated to produce water repellency and limit absorption of moisture from both liquid and vapor phase.

4.1.3 Vermiculite loose fill insulation has five grade designations established by range of particle size distribution as shown in Table 1.

### 5. Ordering Information

5.1 All purchase orders should designate both type and grade of insulation desired. If type designation is omitted, Type

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<sup>2</sup> Annual Book of ASTM Standards, Vol 04.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.06.

<sup>4</sup> Annual Book of ASTM Standards, Vol 04.07.

TABLE 1 Density Specifications

Grade Designation	Bulk Density, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	
	min	max
0—Premium	3.0 (48)	5.0 (80)
1—Large	3.7 (59)	5.5 (88)
2—Medium	4.0 (64)	6.0 (96)
3—Fine	4.5 (72)	7.0 (112)
4—Super Fine	5.5 (88)	8.0 (128)

I will be furnished. The type and grade classifications in this specification differ from the classifications in earlier issues. Purchasers referencing this specification should include the date of issue.

6. Materials and Manufacture

6.1 Vermiculite is a micaceous mineral which is mined and processed to produce a high-purity concentrate. The concentrate, in the form of flakes of varying size and thickness weighing 55 lb/ft<sup>3</sup> (880 kg/m<sup>3</sup>), is expanded in high-temperature furnaces to densities in the range from 3.0 to 8.0 lb/ft<sup>3</sup> (148 to 128 kg/m<sup>3</sup>). As a naturally occurring mineral, it is classifiable as an elementary building material. It is noncombustible as determined by Test Method E 136. Material must pass combustion test criteria of Test Method E 136.

7. Physical Requirements

7.1 The physical requirements listed in this section are defined as Inspection Requirements (see Criteria C 390, 5.1.2; see also Terminology C 168). The insulation shall conform to the following requirements:

	Type I	Type II
Bulk density, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	See Table 1	
Grading (particle size)	See Table 3	
Water properties, max g wicked in 5 min	N.A.	3

7.2 The physical properties listed in this section of the specification are defined as Qualification Requirements (see Criteria C 390, 5.1.1). The insulation shall conform to the following requirements:

	Type I	Type II
Thermal resistance, °F·h·ft <sup>2</sup> /Btu (K·m <sup>2</sup> /W)	See Table 2	
Moisture absorption, max, % by weight/14 days	3.5	3.5
Combustibility	No flaming, glowing, or smoking	
Surface-burning characteristics (Test Method E 84):		
Flame spread, max	0	0
Smoke developed, max	0	0
Water properties, min, mL of water repelled	N.A.	175

8. Sampling

8.1 For purposes of standard tests, sampling shall be in

TABLE 3 Grading Cumulative Percent Retained

Grade Designation	U. S. Sieve No.						
	3/8 in. (9.5 mm)	4 (4.75 mm)	8 (2.36 mm)	16 (1.18 mm)	30 (600 μm)	50 (300 μm)	100 (150 μm)
0—Premium	30–80		80–100				
1—Large	0–10			90–100			
2—Medium		0–10	45–90		95–100		
3—Fine			0–10		90–100		
4—Super Fine				0–5		60–98	90–100

accordance with Criteria C 390.

9. Test Methods

9.1 The physical properties, as enumerated in Section 7, shall be determined in accordance with the following methods:

9.1.1 Bulk Density—Test Methods C 520, Method A.

9.1.2 Grading—Test Method C 136, except that when a mechanical sieving device is used, the sieving time shall be 5 min and the test specimen shall be 50 g of material.

TABLE 2 Thermal Resistance

Grade Designation	Thermal Resistance <sup>A</sup> for 1 in. (25.4 mm) Thickness °F·h·ft <sup>2</sup> /Btu (K·m <sup>2</sup> /W) Mean Temperature, °F (°C)		
	-119 (-84)	40 (4)	75 (24)
0—Premium	...	...	2.3 (0.41)
1—Large	...	...	2.3 (0.41)
2—Medium	...	...	2.3 (0.41)
3—Fine	...	...	2.3 (0.41)
4—Super Fine	3.4 (0.58)	2.5 (0.43)	2.3 (0.41)

<sup>A</sup> The thermal values in this table are given at 1 in. (25.4 mm) of thickness with a gradient of 50°F (28°C). Test data that cover the thickness range from 1 to 6 in. show that thermal resistance per inch of thickness is essentially linear with respect to thickness. Test values do not deviate on the low side from the value in the table by more than 5%.

9.1.3 Thermal Resistance—Tests for thermal resistance may be made in accordance with Test Methods C 177 or C 518. Test at the design density. The thermal resistance of the various types shall not be lower than the values listed in Table 2, except that the average thermal resistance of any four specimens may fall up to 5% below the value in the table. Determine the thermal resistance (R-value) at mean temperature of 75°F (24°C) and 40°F (4°C), at design density and in accordance with the current editions of Test Methods C 177 or C 518. Report the direction of heat flow. Thermal resistance at other mean temperatures may be determined if required.

9.1.4 Moisture Absorption—The test specimen shall be a sample of approximately 50 g. Loose fill the sample and level into a sample holder 9 by 9 by 5 in. (228 by 228 by 127 mm) deep.

9.1.4.1 Condition with minimum air movement across the sample surface. Condition at 50 ± 2% relative humidity and 120°F (48.9°C) to constant weight and record. State the density of the sample conditioned to constant weight in the report of results.

9.1.4.2 Increase the relative humidity to 90 ± 2%. Condition to constant weight by check-weighing at 24-h intervals. Determine the moisture pickup as a percent of conditioned weight.

9.1.4.3 Record percent absorption at 14 days.